ON *ARBERIA* WHITE, AND SOME RELATED LOWER GONDWANA FEMALE FRUCTIFICATIONS

by J. F. RIGBY

ABSTRACT. The genus *Arberia* White and its type species *Arberia minasica* White are redefined, and are shown to be female pteridospermous fructifications that bore large numbers of naked ovules on pinnate branchlets arranged laterally along a forked rachis. It forms the basis of the family Arberiaceae. Other similar fructifications from Santa Catarina, Brazil, and New South Wales, Australia, are also mentioned, but are not named.

THE Lower Gondwana, or Glossopteris Flora is typified by an abundance of leaves belonging to the form genera *Glossopteris* and *Gangamopteris*. The original authors and many of their early successors considered these leaves to belong to ferns. White (1908) was the first to consider them to be the leaves of pteridosperms. With the description of attached fructifications by Plumstead (1952) and a large variety of non-pteridophytic cuticles by Srivastava (1956) their spermophytic affinity was confirmed. The fructifications described here are, in my opinion, more closely related to the pteridosperms than to any other group of seed-bearing plants, and although isolated, I think they belong to plants bearing leaves of the *Glossopteris–Gangamopteris* alliance. I shall treat these fructifications as pteridospermous but I am aware that the discovery of more material may indicate some other affinity.

LOCALITIES

Specimens from localities in the State of Santa Catarina, Brazil, and New South Wales, Australia, are discussed. All localities are in rock units of Lower Gondwana age.

The standard Lower Gondwana sequence in Santa Catarina (omitting some units) is:

Passa Dois Group	Estrada Nova Formation	
	Iratí Formation	
Tubarão Group	Palermo Formation	
	Rio Bonito Formation	Treviso Coal
		Barro Branco Coal
		Camada Irapuá
		Ponte Alta Coal
		Camada Joaquim Branco
	Orleães Formation	

The corresponding sequence in the lower Hunter Valley of New South Wales is:

Newcastle Coal Measures
Tomago Coal Measures
Maitland Group
Greta Coal Measures
Dalwood Group

Information concerning the Brazilian localities is detailed, but for the Australian

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localities is based entirely on the museum card accompanying the specimen, which is the only information available. Description of the individual localities follows.

Bainha. This locality is named after a suburb of the city of Criciuma, state of Santa Catarina, Brazil. The locality occurs in mudstones of the Camada Irapuá, Rio Bonito Formation of the Tubarão Group, in a cutting on the western side of Rua Dr. João Pessôa approximately 1,150 metres from the corner of Praça Dr. Nereu Ramos. It was discovered by Sr. Aristides Nogueira da Cunha of the Divisão de Geologia e Mineralogia, Departamento Nacional da Produção Mineral, Rio de Janeiro (Dolianiti 1946).

Lauro Müller. I. C. White (1908, p. 65) reported the discovery of a locality as 'Joaquim Branco Plant Bed. Along the Estrada Nova, one-half kilometer north of the railway station at Minas . . .' (Minas was the old name for the city now known as Lauro Müller). D. White (1908) reported many species in lots 3586 and 3921. His list of fossils agreed with the list given by I. C. White, although he (D. White, p. 357) described the locality in the English text as 'Northeast of Minas; 55 meters above the granite, or 225 meters below the Iraty (Iratí in modern orthography) black shale'. The Portuguese text uses 'noroeste' which is correct. Throughout the text 'noroeste' has been consistently translated as 'northeast' hence discrepancies between the locality information given by I. C. White and D. White have never been apparent to Brazilian geologists. These papers are written in both English and Portuguese, with the English text compiled by I. C. White or D. White on the odd numbered pages and the Portuguese text compiled by E. P. de Oliveira on the facing, even numbered page. Oliveira has been credited as translator. Mendes (1952, text-fig. 2) has given a columnar section based on the data of I. C. White. In this section the Lauro Müller fossil locality is identified as '(I) Fossil Plants'. This locality was the source of all D. White's specimens of *Arberia minasica.* My material is based on collections made over the last 25 years by staff members of the University of São Paulo.

Barro Branco. Dr. Yoshida of the University of São Paulo, who collected the specimens, informed me that the locality is situated along the Lauro Müller to Barro Branco road, about two kilometres from Lauro Müller, and probably immediately underlying the Camada Bonito of the Rio Bonito Formation.

Putzer (1955) has described the geology for the above parts of southern Santa Catarina.

Adamstown. This is a suburb of Newcastle, New South Wales, Australia.

East Maitland is approximately 16 miles to the west of Newcastle. No information concerning the location of the plant localities or the collectors is available. All rock outcrops at Adamstown are sediments of the Newcastle Coal Measures; those at East Maitland are of the underlying Tomago Coal Measures.

The approximate geographical coordinates of these localities are: Bainha: W 49° 22′, S 28° 41′; Lauro Müller: W 49° 24′, S 28° 24′; Barro Branco: W 49° 24′, S 28° 25′; Adamstown: E 151° 43′, S 32° 57′; East Maitland: E 151° 36′, S 32° 46′.

Specimens prefixed by DGP 7/ are housed in the Cadeira de Paleontologia, Instituto de Geociências e Astronomia, Univeridade de São Paulo, and by NSW are housed in the Mining Museum, Sydney, New South Wales.

PRESERVATION OF SPECIMENS

The specimens described here are all preserved in rather soft rocks. Those from Bainha are in a pink to brown claystone, as are some of those from Lauro Müller and Barro Branco but others are in a yellow or orange argillaceous sandstone. The Australian specimens are in similar but slightly harder rocks. In every specimen the original organic or coaly substance has vanished entirely. In some it has left a cavity which is purely an impression but in others the substance has been replaced by a powdery pinkish mineral. The surface may show some fine features, but there is no possibility of preparing a cuticle or of demonstrating internal anatomy.

DESCRIPTIVE TERMINOLOGY

The fructifications are thought most likely to be pteridospermous. They are all described as megasporophylls consisting of a primary rachis, which may fork but may not. The rachis and its forks branch in an irregularly pinnate manner and the secondary branches may themselves bear a branch of considerable size. The rachis, its forks, and its branches all bear ultimate branchlets and those may end in an ovule or be sterile. They never have a lamina. The ovules are of various sizes and the small ones are considered to be immature. It is impossible to say whether the large ones have been pollinated or fertilized; if they were fertilized they would qualify for the description as seeds, but I disregard this possibility and call them all ovules.

DESCRIPTION OF NEW MATERIAL FROM BRAZIL

The specimens described here are in various stages of development, but as they appear to have been shed before growth was complete, they represent abortions. As is shown below they form a sequence grading from one form to another, hence they may be assumed to show various phases of normal development.

1. *Specimens from Lauro Müller*

The specimen DGP 7/1060 shown in Pl. 24, fig. 1 is one of the best. Its thick rachis forks and bears small ultimate branchlets one of which shows a small ovule 2·5 mm × 2·1 mm near the top, and there seem to be several others but they are less clear and complete. All these ovules are small and are considered young. The rachis and its branches are longitudinally striate, the coarser striations being obvious, but there are also fine ones at 5 per mm. These striations have a wavy course and branch and fuse. The coarse and fine striations are useful in indicating the direction of a branch which might otherwise be doubtful as there is much overlap.

Pl. 24, fig. 7 (specimen DGP 7/1061) shows parts of two fructifications, one overlying the other. They are, like the one in fig. 1, mineral replacements. The main vertically orientated one bears a small ovule near its top; the fine striations of the branchlet bearing it indicate some twisting. This main specimen resembles Millan's *Dolianitia opposita* (his 1967 pl. 1, fig. 4) and also his *D. alternata*.

The fragment in Pl. 26, fig. 3 (specimen DGP 7/1062) shows four of the ultimate branchlets which bear no other structures. This fragment is like that of D. White

(1908, pl. 8, fig. 8). There are also a number of poorly preserved specimens from this locality.

2. *Two specimens from Barro Branco*

One of these is seen in Pl. 24, fig. 2 (specimen DGP 7/1063); it is very unusual but linked with normal ones by intermediates. I take it to be the youngest specimen of all. The secondary branches (pinnae) are here very short and curve back over the main rachis with the undeveloped ultimate branches appearing as marginal lobes. The second specimen is a poorly preserved collection of branchlets and ovules.

3. *Specimens from Bainha*

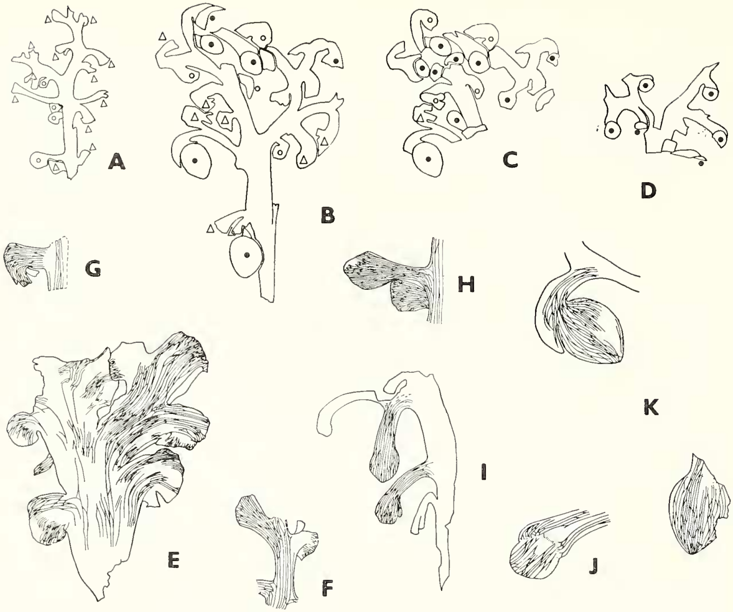
The specimen in Pl. 24, fig. 3 (DGP 7/1064) is taken as slightly older than the previous specimen (DGP 7/1063). The rachis is wide but broken off at its top (by a fold towards the observer). Secondary branches along the margin are still very short. Over the surface of the rachis there are some tiny lumps which may be the rudiments of ultimate branchlets. They are in oblique rows which are consistent with a spiral arrangement; but since very similar oblique rows are to be seen in the other direction they are equally consistent with alternating rows, if indeed their arrangement is regular.

The specimen in Pl. 24, fig. 4 and also shown in text-fig. 1E (DGP 7/1065) has an unforked rachis and has strongly striated secondary branches bearing rudimentary ultimate branchlets. The striations of certain branchlets (drawn in 1E) show a slight curve which perhaps recalls faintly that of a young fern pinna.

The fine specimen in Pl. 24, fig. 5 (DGP 7/1066) has an unforked rachis. The ultimate branchlets are borne both marginally and across the face of the rachis. If their arrangement is truly regular then perhaps they are in whorls with alternating members. The tips of the ultimate branchlets are folded, the folding is taken as an extension of the curving in the previous specimen. The specimen shown by Feistmantel (1881, pl. 28, fig. 5) is similar except that the ultimate branchlets are longer; this was renamed *A. indica* by D. White. Also White's figure of *A. minasica* (reproduced here on Pl. 25, fig. 3) is the lower part of a sporophyll with still longer lobes.

Specimen DGP 7/1067 in Pl. 24, fig. 6 is taken to be similar but with distinctly more developed pinnae. The lowest on the left terminates in a structure suggesting the upper part of an ovule which is not obvious in the figure; the other pinnae are folded. Some branchlets arise across the face of the unforked rachis.

I suppose that the specimen in Pl. 24, fig. 8 developed slightly differently. Here the main rachis forks and the pinnae are longer but the ultimate branchlets are very feebly developed. This specimen had been figured earlier by Rocha-Campos (1967, pl. 33, fig. 4), as *Pluma* sp., a determination made by Yoshida. Three of Millan's (1967) specimens of *D. opposita* look to me very similar (Millan, pl. 1, figs. 1, 1*a*, 5; pl. 2, fig. 1; the first is the type of the species and genus). Some of his other specimens look slightly different but in my judgement ought not to be separated as different species without much clearer evidence. For reasons that will be discussed in the systematic portion of this paper, specimens with a distinctly forked rachis and with pinnae arranged marginally are considered to be examples of *Arberia*, such as this specimen, whereas the few specimens lacking the forked rachis and having branchlets both along the margins and across the face of the rachis (e.g. Pl. 24, figs. 3, 5, 6) are excluded.



TEXT-FIG. 1. *Arberia minasica* White. A–D, show interpretation of the function of growing points, natural size. The symbols indicate: Δ, developing non-ovulate pinna; o, developing ovulate pinna; •, ovule. A, Specimen DGP 7/1069, an expanded but immature example. B, Specimen DGP 7/1070, an expanded, mature specimen showing ovules in various stages of growth. C, Specimen forming the counterpart of DGP 7/1070, drawn as a mirror image; branching pinnae do not correspond entirely with those shown on B because branching in upper part of fructification is so complex. D, Specimen DGP 7/1077, showing complexity of branching.

E–K show superficial features of growing points at various stages of development, ×2. E, Specimen DGP 7/1065, showing more closely spaced lineations at unexpanded tips. F, Specimen DGP 7/1069, showing a folded and an unfolded tip; most lineations connect base of fructification with growing points, but a few join one growing point with the lineations leading to higher growing points. G, Specimen DGP 7/1070, a folded pinna. H, Specimen DGP 7/1069, showing typical pinna forms before elongation becomes significant; the upper is considered to be a developing ovule, and the lower a sterile pinna. I, Specimen DGP 7/1076, showing elongated pinna lobes of smaller size than in the previous specimens, this may be of specific significance; the slight lobe on right of lower pinna showing lineations is probably the beginnings of a branch. J, Specimen DGP 7/1070 (counterpart), where a definite boundary has developed between the pinna and the ovule. K, Specimen DGP 7/1070; lower ovule appears to be terminal on a pinna, whereas upper ovule is attached to lower side of a pinna.

The specimen in Pl. 25, fig. 1 has both a more or less fully developed rachis and pinnae. The pinnae themselves fork or give off a strong branch, and the ultimate branchlets are expanded and many end in a swollen tip, a young ovule. Others end without a swelling and are evidently sterile. An analysis of this specimen is given in text-fig. 1A where young ovules and sterile branchlets are distinguished while text-fig. 1F shows two tips with their striations, one tip being folded, the other flat.

The specimen in Pl. 25, fig. 2 is still older and is regarded as almost mature. Here some of the ovules are distinctly larger than others. The specimen is analysed in text-fig. 1B for developed ovules, small ovules, and sterile branchlets. It is possible that the larger ovules have already been pollinated and even fertilized in which case they would be seeds, but on analogy with what we know of certain other pteridosperms where fertilization occurred long after the ovules were shed, it is best to call them ovules. Two of the larger ovules are shown in detail in text-fig. 1K; the upper appears to be on the face of some sort of disc which is possibly a development from the smaller ovule shown by text-fig. 1J; but the effect may have been produced by folding. The lower ovule appears to be pendulous on the end of a short stalk. The counterpart of this specimen is represented in text-fig. 1C, but for convenience in comparison a mirror image has been made. Some of the ovules and branchlets are evidently the same but others are different because some of the crowded branchlets had lain in a different plane and so do not appear in text-fig. 1B. The specimen identified as *Baiera* from a *Glossopteris–Vertebraria* association in Queensland by White (1961, p. 1, figs. 5, 6) is closely similar to the right-hand upper branch of my specimen.

Another specimen (DGP 7/1077; text-fig. 1D) has nearly all its branches terminated by ovules, and I feel sure that all branches were at least potentially fertile. It is evident that there is not only variation in the stage of development, but the details of branching vary from specimen to specimen.

Specimen DGP 7/1071 (Pl. 25, fig. 4) has its secondary branches (pinnae) all emerging from the rachis in the same plane, but the ultimate branchlets are in different planes; for instance the lowest pinna on the right has one branchlet ending in a swelling but the other projects downwards and backwards into the rock.

The rather large primary rachis (DGP 7/1072; Pl. 25, fig. 5) has laterals on which no further branching can be recognized; probably it is a fragment of a large sporophyll apparently larger than the sporophyll DGP 7/1070 (Pl. 25, fig. 2). Millan (1967, pl. 3, figs. 3, 3*a*; pl. 4, figs. 2, 2*a*) illustrated two rather similar specimens as *D. crassa*.

A better specimen of similar appearance is shown in Pl. 25, fig. 6 and to me resembles *D. crassa* of Millan (pl. 3, figs. 2, 2*a*). Another similar specimen (not figured) looks like that of Plumstead (1958, pl. 23, fig. 1) named *Pluma longicaulis* male, but there is certainly not enough evidence to identify *Pluma* with *Arberia*, and I do not do so.

The specimen in Pl. 25, fig. 7 is, I presume, a detached pinna bearing several ovulate ultimate branchlets. The enlarged tips look as though folded, but after removal of a small fragment of a tip, it can be seen that this appearance is not caused by a fold but is merely a groove between the stalk and the rounded head. Lundqvist's specimens (1919, pl. 1, figs. 25, 26, 29) have similar or slightly smaller ovules, but they differ in showing a broad border (sarcotesta) not seen in any of mine. I think therefore that his specimens which he named ?*A. brasiliensis* are most probably distinct.

The fragment in Pl. 26, fig. 1 has similar ovule-bearing branchlets. One on the right has a distinct rim where the ovule meets its branchlet and this clearly corresponds to the grooves in the previous specimen. There is apparently a difference in the internal tissue at this point but the fine striations which I suppose are more superficial cross unbroken from the branchlet to the ovule (text-fig. 1I).

I consider it unwise to suggest a determination for these ovules as features normally used for even generic identification of isolated seeds are not apparent. A wide variety of isolated seeds are known from these localities (Millan 1965). D. White (1908, pp. 540–541) thought the seeds he named *Cardiocarpon* (*Samaropsis*) *Seixasi* probably were derived from fructifications of *Arberia minasica*.

DEVELOPMENT OF THE MEGASPOROPHYLL AND OVULE

I have interpreted the series of specimens that I determine as *A. minasica* as being at various stages of growth and development. I suppose that the parent plant dropped many of its fruiting megasporophylls at early stages as do many modern trees. These are thus abortions which though reflecting normal development may not be exactly young stages of any normal and fully functional organ. After this warning I proceed to treat the specimens as a normal sequence, though being aware that certain deviations are caused by the earlier failure of nutrition of some parts before the whole organ fell and perished.

The first part to develop is the broad rachis. We do not know how thick its substance becomes, but it was probably not cylindrical. The rachis presumably either forks (dichotomizes) or else remains simple when very young and of minute size. We have no specimen illustrating this. No doubt also the lateral branches (pinnae) originate early, the first we see of them are short outgrowths which bend back over the sides of the rachis (Pl. 24, fig. 2). These laterals may remain simple or may themselves branch by more or less equal forking (Pl. 24, fig. 3). Still later little outgrowths develop on the pinnae (Pl. 24, fig. 4) and sometimes on the face of the main rachis (Pl. 24, fig. 5) and these are the ultimate branchlets. At first they are short and their ends bend back (Pl. 24, figs. 5, 6),

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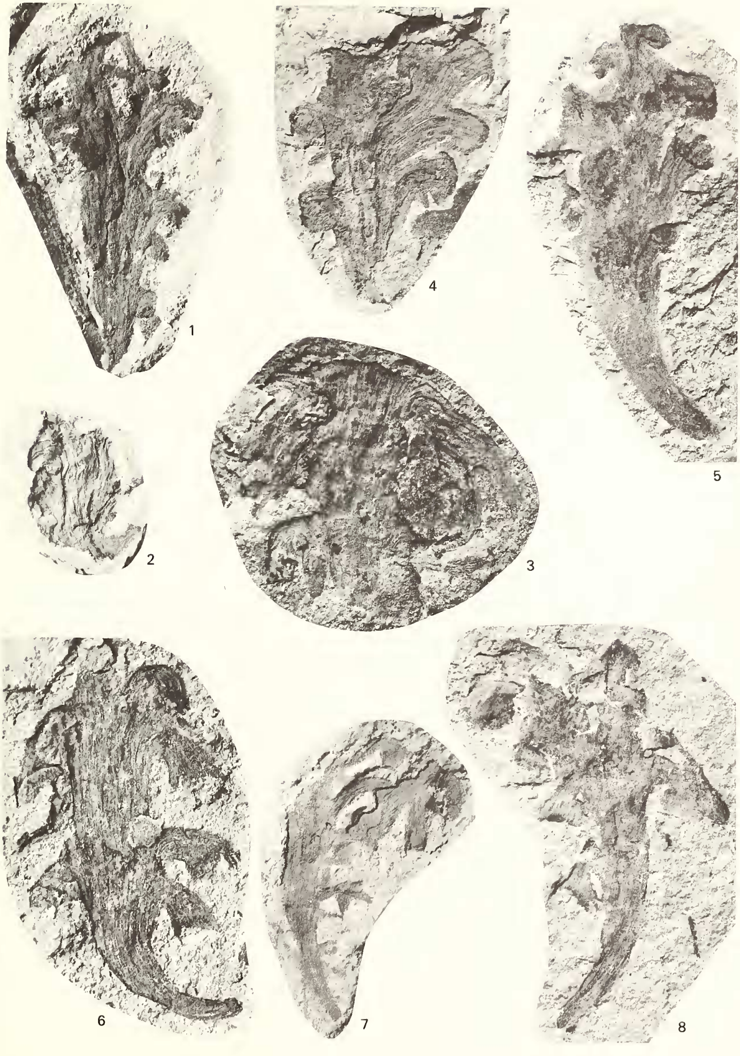
EXPLANATION OF PLATE 24

All figures twice natural size.

Figs. 1, 2, 4, 7, 8. *Arberia minasica* White. 1, Expanded specimen with a few ovulate structures; fine lineations cover the entire organ, coarse lineations or sulci lead upwards to margins of pinnae; DGP 7/1060, Lauro Müller. 2, Juvenile form with folded marginal lobes along the broad rachis which are pinnae; apex broken along a fold coming towards the viewer; DGP 7/1063, Barro Branco. 4, Juvenile form in a more advanced stage than the previous specimen; pinnae have commenced unfolding, the folded lobe always lying on the basal side of the pinna; DGP 7/1065, Bainha. 7, Upright specimen on the left is a rachis with the upper, forked portion missing, small ovules are developing; the broad axis lying diagonally in the upper right is a fragment of another fructification; DGP 7/1061, Lauro Müller. 8, Specimen showing a well developed fork in the rachis; pinnae are still unfolding; DGP 7/1068, Bainha.

Figs. 3, 5, 6. *Arberia*-like fructifications. 3, Much larger specimen than in fig. 2 showing unfolding of the pinnae; upper part of the rachis is folded towards the viewer; tubercles present across the front of the rachis suggest that branches may have been present; DGP 7/1064, Bainha. 5, More elongated specimen than shown in fig. 4, but the base is not broken; pinnae arise both marginally and across the face of the rachis; DGP 7/1066. 6, Unusually elongated specimen; pinnae almost completely unfolded; DGP 7/1067.



RIGBY, Lower Gondwana fructifications

but later they elongate and also straighten (Pl. 25, fig. 1). Many fail to develop further; this may be a common and normal feature of *Arberia* or may reflect the beginning of the failure of nutrition of that specimen. If successful, however (Pl. 25, fig. 2), the swelling enlarges and becomes an ovule and this it seems is not necessarily terminal but may be placed on the side of its branchlet just before its end (text-fig. 1K). At the base of the larger ovules a transverse groove forms marking it off from the branchlet, and this I imagine is caused by the development of a stone inside the ovule. There is no evidence to show at what stage of ovule growth pollination might occur, or fertilization, but if *Arberia* is like the better known pteridosperms fertilization would occur after the ovule had fallen off. The largest ovules are rounded, 6 mm wide, and 8 mm long, but unfortunately their form in section, round or flat, is unknown and the micropyle is not recognizable. They do not seem to have possessed any soft layer around their stone or this would have formed a rim of compression. We know nothing at all of the further history of the fructification.

TEXT-FIG. 2. Restoration of a mature specimen of *Arberia minasica* White, based largely on specimens DGP 7/1070 and DGP 7/1077. A number of branched pinnae in the background, near the top, have been omitted from the figure for clarity. Irregularities as shown here departing from the pinnate form have been caused by crowding from swollen ovules and from much-branched pinnae.

SYSTEMATIC POSITION OF *ARBERIA*

If the whole specimen is a megasporophyll, that is an ovule-bearing leaf which branches in a pinnate manner, it follows automatically that it is to be placed in or near the pteridosperms. There is no other class that could accommodate it. As first defined the class Pteridospermae had a fairly precise meaning but a considerable variety of fossils have been placed in it without its redefinition and its meaning has become unfortunately vague. Clearly my preserved specimens give me no basis for redefining it but I merely say that by pteridosperm I mean a plant bearing its gymnospermous ovules terminally on pinnately branching structures. Of course the other organs have characters too but the present work does not deal with them.

The pteridosperms include many diverse genera which have been placed in a number of families which largely, no doubt because they are imperfectly known, have only obscure relationships. *Arberia* is a single organ. Relationships obviously pertain to whole plants and not to single organs. We do not even know its leaf. I think specially of *Glossopteris* and *Gangamopteris* which are both associated with it but have no proof of connection. *Arberia* does not resemble the better-known attached glossopterid fructifications such as *Scutum*, *Lanceolatus*, and *Ottokaria*. The fructification does not belong to the same plant as the cordaitalean leaves, *Noeggerathiopsis*, as it does not resemble known cordaitalean fructifications where megasporophylls occur on short shoots as in *Cordaianthus pseudofluitans* (e.g. see Florin 1944, pl. 173/174, fig. 10 and text-fig. 45).

Arberia does not lie within established pteridosperm families as the fructification lacks any evidence of pinnules or cupulate structures. The ovules are not arranged on a peltate disc. Comparison with the family Medullosaceae is not possible as there single ovules replace occasional pinnae.

Family ARBERIACEAE fam. nov.

Diagnosis. Female fructifications of branched or unbranched rachis bearing laterally inserted pinnae which are simple, bifid or multifid with terminal or laterally placed solitary ovules. Pinnules with a lamina, cupules and other sterile structures absent.

Type genus. Arberia White.

Genus ARBERIA White, emend.

1908 *Arberia* White, pp. 536–539.

Emended Diagnosis. Small megasporophyll having a relatively broad, longitudinally striated rachis, usually forking towards the apex. Rachis pinnate; pinnae commonly forked, and bearing ultimate branchlets along their margins, the lowest being lateral to the pinna, but terminally forming a group by frequent apical forking. Pinnae branchlets simple, either sterile and forming short rods, or fertile and ending in a rounded ovule situated on its surface either terminally or just below its apex. Ovule with a hard layer but no wing or outer flesh, micropyle not observed. No lamina developed at all. (No microscopic details of sporophyll or ovule known.)

Type species. Arberia minasica White.

Arberia minasica White, emend.

Plate 24, figs. 1, 2, 4, 7; Plate 25, figs. 1, 2, 4, 6, 7; Plate 26, figs. 1, 2, 4; Text-figs. 1A–1K

1908 *Arberia minasica* White, pp. 540–543, pl. 8, figs. 8–10.
1961 Frond of *Baiera*, in White, pp. 1–2, figs. 5, 6.
1965 *Ottokaria*-like head; Pant and Nautiyal, pp. 623–624 (pars), figs. 5, 6.
1966 *Ottokaria*-like head; Pant and Nautiyal, pp. 98–99, fig. 1 only.
1967 *Dolianitia alternata* Millan, pp. 9–10, pl. 2, fig. 2.
1967 *Dolianitia crassa* Millan, pp. 10–12 (pars), pl. 3, fig. 2; pl. 4, fig. 1.

Emended Diagnosis. Mature female fructification about 6 cm long, main rachis about 6 mm wide in the middle but narrower below, divides once in the upper half. Lateral

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EXPLANATION OF PLATE 25

All figures twice natural size.

Figs. 1–4, 6, 7. *Arberia minasica* White. 1, Fully expanded specimen with a monopodial branching of the rachis, showing branching in the pinnae; ovules are developing as expanded terminal lobes of the pinnae; DGP 7/1069, Bainha. 2, Mature specimen bearing a few ripe ovules, and many developing ovules terminally on pinnae; branching in rachis monopodial, and within pinnae dichotomous; DGP 7/1070, Bainha. 3, Photographic reproduction of plate 8, fig. 10 of White 1908. 4, A number of ovulate, branched pinnae attached to a rachis. 6, Forked rachis with only one of its upper branches retained; terminal ovule borne on a pinna; DGP 7/1073, Bainha. 7, A cluster of branchlets arising from a single pinna; branchlets each end in a folded lobe; DGP 7/1074, Bainha.

Fig. 5. *Arberia* sp.; poorly preserved rachis bearing a number of recurved processes which have the dimensions of ovules; DGP 7/1072, Bainha.

RIGBY, Lower Gondwana fructifications